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Indian Standard

SHIPBUILDING — STEAM TRAPS — GUIDELINES FOR SELECTION

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 2

Marine Engineering Sectional Committee, TED 19

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 18 August 1989, after the draft finalized by the Marine Engineering Sectional Committee had been approved by the Transport Engineering Division Council.

Indian Standard

SHIPBUILDING — STEAM TRAPS — GUIDELINES FOR SELECTION

1 SCOPE

1.1 This standard specifies guidelines for selection of steam traps for various application on board ships.

2 ASSESSMENT OF CONDENSATE FLOW RATES

2.1 kg condensate/h of 30 m of insulated steam main line at 21°C ambient.

Steam Pressure (*bar*)	*Steam Main Size*					
	50	80	100	150	200	250
	(mm)					
0·7	3	4	5	8	10	12
4	5	7	9	14	17	21
7	6	9	11	16	20	25
20	10	15	19	28	35	44
42	15	22	28	41	52	64

2.2 Steam Tracing Lines

Approximate load is 30 kg/h for each 30 m of tracerline.

2.3 General Usage Formulae

1 *Heating Water with Steam*:

$$\text{kg condensate/h} = \frac{\text{l/h of water} \times \text{temp rise}^\circ\text{C}}{500}$$

2 *Heating Fuel Oil with Steam*:

$$\text{kg condensate/h} = \frac{\text{l/h of fuel oil} \times \text{temp rise}^\circ\text{C}}{100}$$

3 *Heating Air with Steam*:

$$\text{kg condensate/h} = \frac{\text{m}^3\ \text{min of air} \times \text{temp rise}^\circ\text{C}}{27}$$

2.4 Heating Liquids in Steam Jacketed Kettles

$$\text{kg condensate/h} = \frac{W \times C_p \times \Delta T}{L \times t}$$

where

W = weight of liquid to be heated, kg
C_p = specific heat of the liquid, k cal/kg °C
ΔT = temp rise of the liquid, °C
L = latent heat of steam k cal/kg
t = time in hours

2.5 Steam Jacketed Dryers

kg condensate/h

$$= \frac{600\ (W_i - W_f) + (W_i \times \Delta T)}{L}$$

where

W_i = initial weight of the material, kg/h
W_f = final weight of the material, kg/h
ΔT = temp rise of the material, °C
L = latent heat of steam, k cal/kg

2.6 Heating Air with Steam Pipe Coils and Radiation

$$\text{kg condensate/h} = \frac{A \times U \times \Delta T}{L}$$

where

A = area of the heating surface, m²
U = heat transfer coefficient k cal/m² °C (2 for free convection)
ΔT = steam temp minus the air temperature °C
L = latent heat of steam k cal/kg

NOTE — The condensate load to heat the equipment must be added to the condensate load for heating the material, using same formula.

3 ASSESSMENT OF PRESSURE DIFFERENTIAL

3.1 The pressure differential is the difference between the pressure (kg/cm^2) absolute at the trap inlet and that at the trap outlet.

3.2 Pressure at Trap Inlet When Draining Pipes

When steam flows through a pipeline there is a drop in pressure between the beginning and end of the line. If this pressure drop becomes a significant percentage of the initial pressure (say 10 percent) due to length of pipe line and steam velocity, then it is necessary to assess the value and to allow for the reduced inlet pressure for those traps near the end of the line.

3.3 Pressure at Inlet to Trap or Other Device When Draining a Steam Heat User

When the steam is allowed an unrestricted flow into the steam heat user (that is when the equipment is required to perform the maximum of heat transfer) it is only necessary to calculate the drop from initial pressure due to pipe friction (from source to user).

3.4 Pressure at Outlet of Trap or Other Device

The total back pressure is the sum of:

a) The pressure in kg/cm^2 (absolute) into which the condensate finally discharges.

b) The positive or negative static difference between the trap outlet and the final discharge point brought to pressure equivalent (kg/cm^2).

c) The friction loss in the pipe through which the condensate flows (kg/cm^2).

3.4.1 *Friction Loss in Condensate Line from Trap or Other Device*

a) Where the condensate temp is below the saturation steam temp corresponding to a pressure equal to (a) + (b) above that is where no flashing takes place, then it is adequate to assess friction drop by any of the usual formulae for water flow in pipe.

b) Where condensate temp is such that flashing will occur as the condensate enters the lower pressure zone in the condensate main, the normal water flow formulae are inadequate because both steam and water are passing in the line. In order to assess the friction loss in condensate lines where flashing occurs, it is recommended that any of the usual formulae for water flow in pipes be used, but the quantity of condensate flowing be assumed to be equal to $W_m + F$, where F is a flashing factor whose value is assessed as indicated below:

$$F = \frac{5 W_m (T_s - T_b)}{9P}$$

where

F = flashing factor

T_s = temp of the saturated steam being trapped

T_b = temp of the steam corresponding to the back pressure at the trap, neglecting friction, °C

W_m = maximum rate of condensate flow (kg/h)

P = pressure factor (*see* Fig. 1)

3.4.2 *Effect of Back Pressure on Steam Trap Capacity*

The total back pressure will reduce the capacity of the trap by the amount given in Table 1. This does not apply to inverted bucket traps since selection is made considering both inlet as well as back pressure.

Table 1 Effect of Back Pressure on Steam Trap Capacity

(% Reduction in Capacity)

Percent Back Pressure	Inlet Pressure (Bar)			
	0·35	1·7	7·0	14·0
25	6	3	0	0
50	20	12	10	5
75	38	30	28	23

4 SAFETY FACTOR

The ratio between the maximum discharge capacity of a steam trap and the condensate load it is expected to handle is the safety factor. The safety factor is influenced by the following:

a) Operational characteristics of the trap;

b) Accuracy of the estimated or calculated condensate load; and

c) Pressure conditions at the inlet and outlet of the trap.

4.1 If the condensate load and pressure condition can be accurately determined, the safety factor can be held to a minimum, thus avoiding oversizing of the trap. Oversized traps, especially inverted bucket, thermodynamic and balanced pressure thermostatic types, not only cost more initially but also operate less efficiently creating abnormal back pressures and reduced operating lifetimes.

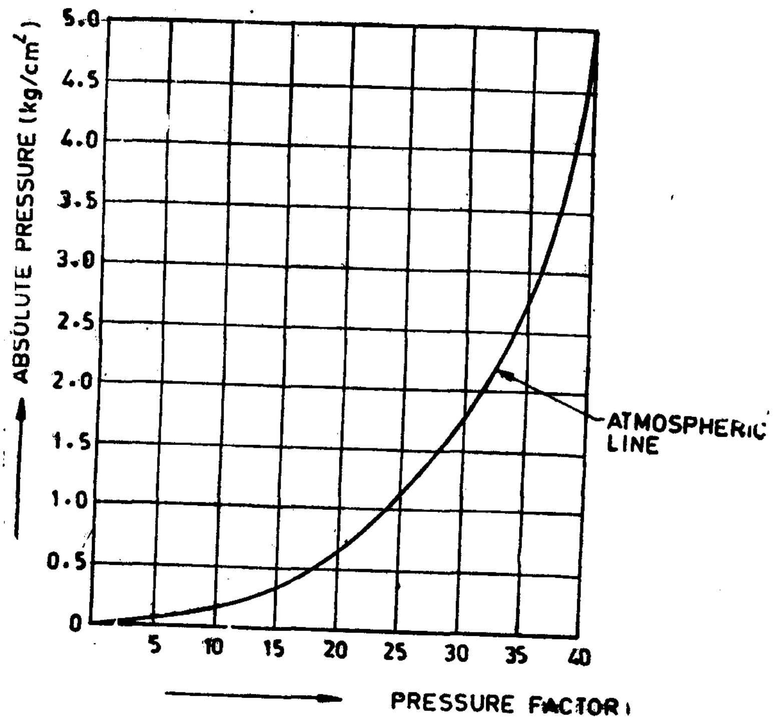

FIG. 1 PRESSURE FACTOR GRAPH

Table 2 shows the recommended safety factors for the various types of steam traps.

5 SELECTION OF STEAM TRAP

5.1 General

Every intending user of steam traps, must ascertain the overall conditions under which a trap is to operate. After these conditions have been determined, however, the individual characteristics of the various types of steam trap must be considered in order to select the most suitable trap for a particular application.

5.2 Fundamental Factors Affecting Selection

A steam trap must be suitable for the steam, condensate and installation conditions. The steam trap selection table lists the factors relating to these conditions.

5.3 Maximum Steam Pressure and Temperature

Having selected a suitable type (or types) of trap from the selection table the user must then ascertain from the data published by the manufacturer(s) whether the type(s) chosen is available for the required pressure.

Table 2 Recommended Safety Factor for Steam Traps

(*Clause* 4.1)

Type of Trap	Safety Factor
Vapour-pressure thermostatic traps	2 to 4
Liquid expansion traps	2 to 4
Bimetallic traps	2 to 4
Float traps	1·5 to 2·5
Inverted bucket traps	2 to 3
Thermodynamic traps	1·2 to 2

NOTE — The actual safety factor to be used for any particular application will depend upon accuracy of the following:

1 Estimated load

2 Estimated pressure at trap

3 Estimated back pressure

Any unusual or abnormal conditions must be taken into consideration.

5.4 Steam Trap Selection General Guide

Application	*Type of Trap*
a) Air heating coils	
i) Low and medium pressure	Float/Inverted bucket type
ii) High pressure	Float/Inverted bucket type
b) Hot water heaters (Instantaneous)	Float/Inverted bucket type
c) Hot water heaters (storage)	Float/Inverted bucket type
d) Shell and tube exchanger	
i) Small — high pressure	Vapour pressure/Thermostatic
ii) Large — low and medium pressure reboilers	Float/Inverted bucket type
e) Steam humidifiers	Float/Inverted bucket type
f) Steam — jacketed vessel	
i) High pressure	Thermodynamic/Float
ii) Low pressure	Float/Inverted bucket type
g) Steam line drip traps	
i) 0 — 1 kg/cm^2	Float/Inverted bucket
ii) Above 1 kg/cm^2 to 8 kg/cm^2	Thermodynamic/Float
iii) Above 8 kg/cm^2 to 40 kg/cm^2	Thermodynamic
iv) High pressure — superheat	Thermodynamic/Bimetallic
h) Steam pipe coils (air heating)	Vapour pressure/Thermostatic
j) Steam radiators	Vapour pressure/Thermostatic
k) Steam separators	
i) 0 — 1 kg/cm^2	Float
ii) Above 1 kg/cm^2 to 8 kg/cm^2	Thermodynamic/Float
iii) Above 8 kg/cm^2 to 40 kg/cm^2	Thermodynamic/Inverted bucket
m) Steam tracer lines	Vapour pressure/Thermostatic/Thermodynamic/Bimetallic
n) Storage tank coils	Float/Inverted bucket
p) Submerged heating coils	
i) High pressure	Thermodynamic/Vapour pressure/Thermostatic
ii) Low and medium pressure	Float/Vapour pressure/Thermostatic
q) Unit heaters	Float/Vapour pressure/Thermostatic

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(Common to all Offices)

Regional Offices :	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 86 62
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